Homework-02 Due Friday Sept.-16, 2005 (prior to class)

1. Derive the expression of acceleration in polar co-ordinates, e.g., \( a_r = \frac{d^2r}{dt^2} - r\left(\frac{d\phi}{dt}\right)^2 \) for the radial and \( a_\phi = r\frac{d^2\phi}{dt^2} + 2 \frac{dr}{dt}\frac{d\phi}{dt} \) for the tangential component. [10 pts.]

2. A particle at rest of mass \( M \) is released from a state of rest on a rotating sloping rigid plane (see Fig. 2-11 on p.30 of Cushman-Roisin). The angular rotation rate is \( \Omega \) about the vertical axis and the angle formed by the plane with the horizontal is \( \alpha \). Friction and centrifugal forces are negligible. What is the maximum speed acquired by the particle and what is its maximum downhill displacement? [10 pts.]